

WHAT IS CLAIMED IS:

1. A method of removing a hard mask layer from a patterned layer formed over an underlying layer, where the hard mask layer is removed using an etchant that detrimentally etches the underlying layer when the underlying layer is exposed to the etchant for a length of time typically required to remove the hard mask layer, without detrimentally etching the underlying layer, the method comprising the steps of:
modifying the hard mask layer so that the hard mask layer is etched by the etchant at a substantially faster rate than that at which the etchant etches the underlying layer,
patterning the hard mask layer,
etching the patterned layer to expose portions of the underlying layer, and
etching both the hard mask layer and the exposed portions of the underlying layer with the etchant, where the etchant etches the hard mask layer at a substantially faster rate than that at which the etchant etches the underlying layer, because of the modification of the hard mask layer.
2. The method of claim 1, wherein the step of modifying the hard mask layer is accomplished prior to the step of patterning the hard mask layer.
3. The method of claim 1, wherein the step of modifying the hard mask layer is accomplished subsequent to the step of patterning the hard mask layer.
4. The method of claim 1, wherein the step of modifying the hard mask layer is accomplished subsequent to the step of etching the patterned layer and prior to the step of etching both the hard mask layer and the exposed portions of the underlying layer.
5. The method of claim 1, wherein the step of patterning the hard mask layer comprises applying and patterning a photoresist layer and etching the hard mask layer.

6. The method of claim 1, wherein the step of modifying the hard mask layer comprises damaging a crystal structure of the hard mask layer.
7. The method of claim 1, wherein the step of modifying the hard mask layer comprises damaging a crystal structure of the hard mask layer with ion implantation.
8. The method of claim 1, wherein the step of modifying the hard mask layer comprises damaging a crystal structure of the hard mask layer by ion implantation of at least one of argon, arsenic, and nitrogen.
9. The method of claim 1, wherein the hard mask layer and the underlying layer are both formed of silicon dioxide.
10. The method of claim 1, wherein the hard mask layer comprises silicon dioxide formed with a low temperature oxidation process and the underlying layer comprises silicon dioxide formed with a thermal oxidation process.
11. The method of claim 1, wherein the hard mask layer has a thickness of from about two hundred angstroms to about five hundred angstroms and the underlying layer has a thickness of about twenty angstroms.
12. The method of claim 1, wherein the etchant comprises a dilute aqueous solution of hydrofluoric acid.
13. The method of claim 1, wherein the underlying layer is a gate insulation layer and the patterned layer is a gate electrode layer.
14. The method of claim 1, wherein the hard mask layer comprises silicon oxynitride formed with a deposition process.
15. The method of claim 1, wherein the etchant comprises an aqueous solution of phosphoric acid

16. A method of using a hard mask layer to pattern a patterned layer formed over an underlying layer, where the hard mask layer is removed using an etchant that detrimentally etches the underlying layer when the underlying layer is exposed to the etchant for a length of time typically required to remove the hard mask layer, without detrimentally etching the underlying layer, the method comprising the sequential steps of:
forming the hard mask layer over the patterned layer,
modifying the hard mask layer so that the hard mask layer is etched by the etchant
at a substantially faster rate than that at which the etchant etches the
underlying layer,
patterning the hard mask layer,
etching the patterned layer to expose portions of the underlying layer, and
etching both the hard mask layer and the exposed portions of the underlying layer
with the etchant, where the etchant etches the hard mask layer at a
substantially faster rate than that at which the etchant etches the
underlying layer, because of the modification of the hard mask layer.
17. The method of claim 16, wherein the step of modifying the hard mask layer comprises damaging a crystal structure of the hard mask layer with ion implantation.
18. The method of claim 16, wherein the hard mask layer and the underlying layer are both formed of one of silicon dioxide and silicon oxynitride.
19. A method of using a hard mask layer to pattern a patterned layer formed over an underlying layer, where the hard mask layer is removed using an etchant that detrimentally etches the underlying layer when the underlying layer is exposed to the etchant for a length of time typically required to remove the hard mask layer, without detrimentally etching the underlying layer, the method comprising the sequential steps of:
forming the hard mask layer over the patterned layer,
patterning the hard mask layer,

etching the patterned layer to expose portions of the underlying layer,
modifying the hard mask layer so that the hard mask layer is etched by the etchant
at a substantially faster rate than that at which the etchant etches the
underlying layer, and
etching both the hard mask layer and the exposed portions of the underlying layer
with the etchant, where the etchant etches the hard mask layer at a
substantially faster rate than that at which the etchant etches the
underlying layer, because of the modification of the hard mask layer.

20. The method of claim 19, wherein the step of modifying the hard mask layer comprises damaging a crystal structure of the hard mask layer with ion implantation.